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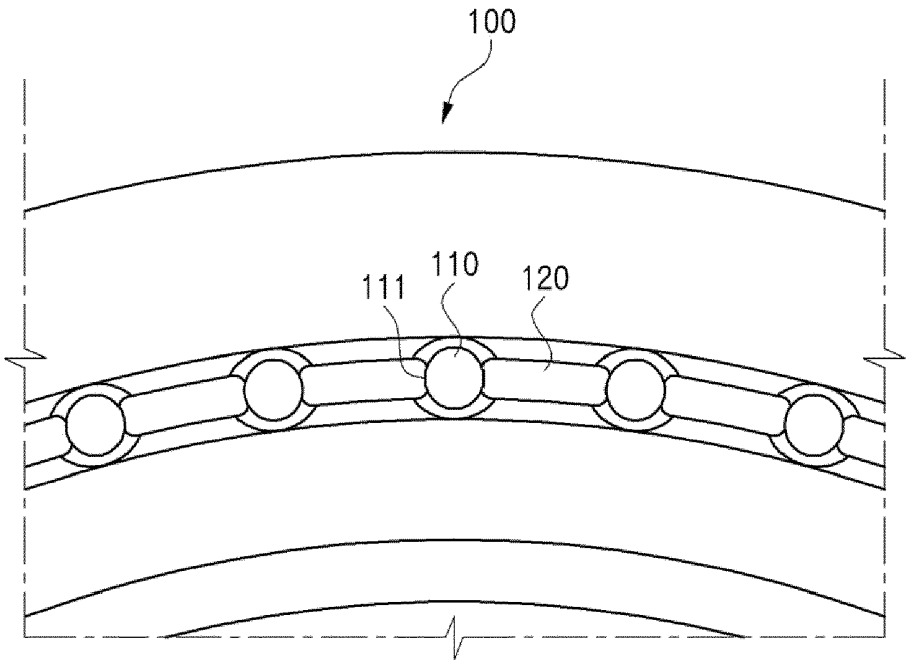
(54) GAS TURBINE DISK

(57) The present disclosure relates to a plurality of disks, on which outer circumferential surfaces a plurality of blades are arranged, and has an objective to provide a gas turbine disk including a plurality of cooling channels penetrating the side surfaces of the disks and spaced from each other in a radial direction, and reinforcement parts coupled to partial arcs of exits of the cooling channels so as to reduce stress concentrated on the cooling channels.

Fig.3



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Description

BACKGROUND

[0001] The present disclosure relates to a disk of a gas turbine and, more particularly, to a structure of a bore part of a gas turbine, in which a groove is provided to the bore part.

[0002] In general, a gas turbine includes a compressor, a combustor and a turbine. Air is introduced through an air inlet and compressed by the compressor so as to be compressed air of high temperature and high pressure. Fuel is supplied with respect to the compressed air by the combustor so as to be burned. The combustion gas of high temperature and high pressure drives the turbine and thus drives a generator connected to this turbine.

[0003] The turbine is formed of a plurality of stators and a plurality of rotors, which are arranged alternately, in a cabin, wherein the rotors are driven by the combustion gas so as to rotate an output shaft connected to the generator. In addition, the combustion gas, which drives the turbine, is converted into static pressure by a diffuser in an exhaust cabin and then discharged into the atmosphere.

[0004] According to recent demands for a gas turbine of a high output and high efficiency, there is a tendency that the temperature of the combustion gas induced into the stators and the rotors is gradually increased. Therefore, typically, cooling paths are formed in the stators and the rotors and a cooling medium is induced to flow through the cooling paths so as to cool the stators and the rotors, thereby securing heat resistance while facilitating the increase of the combustion gas temperature as well as improving an output and efficiency.

[0005] Referring to Fig. 1, a turbine disk 10 has a cooling channel 11 formed along the diameter direction thereof and the front end portion of the cooling channel communicates with a cooling path 12 of a stator main body. In addition, a cooling medium is supplied from a base part with respect to the cooling channel and flows through this cooling channel, thereby cooling the main body of a rotor 20.

[0006] However, such a cooling channel respectively has a portion to which stress is concentrated in the circumferential direction or the diameter direction of the turbine disk. Therefore, there is a problem that the tensile stress has to be minimized.

BRIEF SUMMARY

[0007] Accordingly, the present disclosure has been made to solve the above-mentioned problems occurring in the related art, and it is an objective of the present disclosure to provide a gas turbine disk, in which a reinforcement part is provided to a cooling channel of a gas turbine disk so as to induce stress decrease at a position where the stress has been conventionally concentrated in the circumferential direction or the diameter direction of the turbine disk, thereby improving or maximizing the lifespan of the disk. The object is solved by the features of the independent claim.

[0008] According to one embodiment, a gas turbine disk comprises: a plurality of cooling channels penetrating side surfaces of the disks and spaced from each other in a radial direction; and reinforcement parts coupled to partial arcs of exits of the cooling channels so as to reduce stress concentrated on the cooling channels. In a plurality of disks, a plurality of blades may be arranged on outer circumferential surfaces of the plurality of disks.

[0009] According to an embodiment of the present disclosure, the reinforcement part may be formed in a polygonal or circular shape so as to entirely encompass the exit of a cooling channel. The reinforcement part may protrude in the axial direction of a disk.

[0010] According to an embodiment of the present disclosure, the reinforcement part may be formed to directly connect one cooling channel to another cooling channel, which is adjacent to the one cooling channel. The reinforcement part may protrude in the axial direction of a disk.

[0011] According to an embodiment of the present disclosure, the reinforcement part may continuously encompass the exit of a cooling channel along the circumferential surface of the exit of the cooling channel.

[0012] According to an embodiment of the present disclosure, reinforcement parts may be continuously formed along the circumference formed by the exits of a plurality of cooling channels.

[0013] According to an embodiment of the present disclosure, reinforcement parts may be formed in the shape of a circle, a rectangle or any other polygon.

[0014] According to the present invention as described above, the reinforcement part may be provided to the cooling channel of the disk of a gas turbine so as to induce the decrease of stress concentration, thereby increasing the lifespan of the disk.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 is a partial cross-sectional view of a related art gas turbine disk.

Fig. 2A is a partial cross-sectional view of a cooling channel of a gas turbine disk.

Fig. 2B is a partial cross-sectional view of a cooling channel of a gas turbine disk.

Fig. 3 is a side view of cooling channels and reinforcement parts forming a disk of a gas turbine according to an embodiment of the present disclosure.

Fig. 4 is a side view of cooling channels and reinforcement parts forming a disk of a gas turbine according to another embodiment of the present disclosure, and

Fig. 5 is a perspective view of cooling channels and reinforcement parts of a disk of a gas turbine accord-

ing to still another embodiment of the present disclosure.

DETAILED DESCRIPTION

[0016] Reference will be now made in detail to the preferred embodiments of the present disclosure with reference to the attached illustrative drawings. It should be noted that, in adding reference signs to the constituent elements in each of the drawings, the same constituent elements have the same reference signs even though they are illustrated in different figures. In addition, in the description of the present disclosure, when it is judged that detailed descriptions of known functions or structures may make the essential points vague, the detailed descriptions of the known functions or structures will be omitted.

[0017] Further, in the description of the constituent elements of the embodiments of the present disclosure, it is possible to use terms such as first, second, A, B, (a), (b) and the like. These terms are just to distinguish the constituent elements from any other constituent elements but do not limit the nature or sequence or order and the like of corresponding features by the terms. Additionally, it should be also understood that the expression that some constituent element is "connected", "coupled" or "joined" to another constituent element means that some constituent element may be directly connected or joined to another constituent element or is also "connected", "coupled" or "joined" to another constituent element through a further component therebetween.

[0018] Fig. 3 shows cooling channels and reinforcement parts forming a disk of a gas turbine according to an embodiment of the present disclosure.

[0019] Fig. 4 shows cooling channels and reinforcement parts forming a disk of a gas turbine according to another embodiment of the present disclosure, and

[0020] Fig. 5 shows cooling channels and reinforcement parts of a disk of a gas turbine according to still another embodiment of the present disclosure.

Brief Explanation of Reference Signs

[0021]

100 : disk

110 : cooling channel

111 : partial arc

120 : reinforcement part

[0022] As shown in Fig.3, a gas turbine disk according to an embodiment of the present disclosure may include a disk 100, on which outer circumferential surfaces one or more blades may be arranged, a plurality of cooling channels 110 penetrating side surfaces of the disk 100 and are spaced from each other in a radial direction, and reinforcement parts 120 coupled to partial arcs 111 of exits of the cooling channels 110 so as to reduce stress concentrated on the cooling channels 110. It will be appreciated that a gas turbine may include a plurality fo the gas turbine disks and a plurality of blades. The plurality of blades may be arranged at outer circumferential surfaces of the plurality of disks.

[0023] The cooling channels 110 may be formed penetrating the disk 100 in parallel to the axial direction of the disk 100. That is, the cooling channels 110 are formed through one surface and the other surface of the disk 100 in the axial direction.

[0024] The cooling channels 110 may be hollow parts, each of having a cross section in a circular shape. In addition, in order to prevent or reduce the concentration of stress, the cooling channels 110 may be formed as hollow parts, each of which having a cross section in an oval shape so as to have a long axis in the circumferential direction of the disk 100 or in the radial direction of the disk 100.

[0025] The cooling channels 110 are to enable a cooling medium such as air, steam and the like to flow through the cooling channels 110 so as to cool a stator and a rotor, thereby securing heat resistance while facilitating the increase of combustion gas temperature as well as improving an output and efficiency.

[0026] The reinforcement parts 120 may be formed in a buildup shape so as to reinforce the cooling channels in the axial direction and in the radial direction.

[0027] The reinforcement part 120 according to an embodiment of the present disclosure, as shown in Fig. 3, may be formed in a continuous shape, in which the reinforcement part 120 extends from one end thereof, which is formed at a partial arc 111 of the exit of one cooling channel 110, to the other end, which is formed at a partial arc 111 of the exit of another one cooling channel 110 that is adjacent to the one cooling channel 110. Therefore, the reinforcement parts 120 are formed in a shape, in which the reinforcement parts 120 connect the exits of the cooling channels, which are adjacent to each other, among the plurality of cooling channels.

[0028] That is, the shape, in which the respective reinforcement parts 120 and the cooling channels 110 are formed to be continuously connected, may be the shape of a chain when viewing the side surface of the disk 100 on the whole.

[0029] The above described embodiment, as shown in Fig. 2, may be applied for the reinforcement when the stress is concentrated in the circumferential direction 1 la of the disk 100.

[0030] Further, as shown in Fig. 4, the reinforcement part 120 may be formed to directly connect one cooling channel 110 to another cooling channel 110, which is adjacent to the one cooling channel 110, wherein this reinforcement part 120 may be formed to be protruded in the axial direction of the disk 100.

[0031] The reinforcement parts 120 may be protruded

up to a preferable level according to the degree of the stress applied to the cooling channels 110.

[0032] In addition, according to the embodiment, as shown in Fig. 3, the reinforcement part 120 may continuously encompass the exit of the cooling channel 110 along the circumferential surface of the exit, so as to cope with the stress concentrated in the circumferential direction 11a of the disk 100 as well as the stress concentrated in the diameter direction 11b of the disk 100.

[0033] The protrusion shape may be variously formed, wherein the thickness of the protrusion is preferably formed according to the stress concentration degree in the same way as the embodiment shown in Fig. 3.

[0034] Referring to Fig. 5, the reinforcement part 120 is formed in a polygonal or circular shape so as to entirely encompass the exit, and may be formed to be protruded in the axial direction of the disk 100.

[0035] This feature is to make the reinforcement at a position where rigidity reinforcement is most necessary according to the shape of a cooling concentration portion.

[0036] According to the embodiment of the present disclosure, as shown in Fig. 5, the reinforcement part is in a shape, in which the length in the diameter direction of the disk is long so as to correspond to the stress in the diameter direction 11b.

[0037] The gas turbine disk 100 according to the embodiment of the present embodiment is provided with the reinforcement parts 120 as the protruded buildup parts at the portions to which the stress is concentrated, thereby inducing the decrease of the local peak stress and increasing the low cycle fatigue (LCF) lifespan without requiring laser shock peening (LSP) thereby reducing additional manufacturing processes and reducing the associated manufacturing costs. In addition, the buildup parts, that is, the reinforcement parts 120 may be differently applied to the portions according to whether the circumference direction stress (radial peak stress) or the diameter direction stress (tangential peak stress) is applied thereto, thereby maximizing the effect.

[0038] Hereinabove, even though all of the constituent elements are coupled into one body or operate in a combined state in the description of the above-mentioned embodiments of the present disclosure, the present disclosure is not limited to these embodiments. That is, all of the constituent elements may operate in one or more selective combination within the range of the purpose of the present invention. It should be also understood that the terms of "include", "comprise" or "have" in the specification are "open type" expressions just to say that the corresponding constituent elements exit and, unless specifically described to the contrary, do not exclude but may include additional components.

[0039] All terms, including technical or scientific terms, unless otherwise defined, have the same meaning as commonly understood by those of ordinary skill in the art, to which the present invention belongs. The terms which are commonly used such as the definitions in the dictionary are to be interpreted to represent the meaning that matches the meaning in the context of the relevant art and, unless otherwise defined explicitly in the present invention, it shall not be interpreted to have an idealistic or excessively formalistic meaning.

[0040] As described above, while the present invention has been particularly shown and described with reference to the example embodiments thereof, it will be understood by those of ordinary skill in the art that the above embodiments of the present invention are all exemplified and various changes, modifications and equivalents may be made therein without changing the essential characteristics and scope of the present invention.

[0041] The embodiments discussed have been presented by way of example only and not limitation. Thus, the breadth and scope of the invention(s) should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with the following claims and their equivalents. Moreover, the above advantages and features are provided in described embodiments, but shall not limit the application of the claims to processes and structures accomplishing any or all of the above advantages.

Claims

1. A gas turbine disk, comprising:

   a plurality of cooling channels penetrating a side surface of the disk and spaced from each other in a radial direction; and
   reinforcement parts coupled to partial arcs of exits of the cooling channels so as to reduce stress concentrated on the cooling channels.

2. The gas turbine disk according to claim 1, wherein at least one of the reinforcement parts is configured to entirely encompass the exit of the corresponding cooling channel.

3. The gas turbine disk according to claim 1 or 2, wherein at least one of the reinforcement part is formed in a polygonal or circular shape.

4. The gas turbine disk according to any one of the preceding claims, wherein the reinforcement parts protrude in an axial direction of the disk.

5. The gas turbine disk according to any one of the preceding claims, wherein the reinforcement parts respectively connect exits of neighboring cooling channels among the plurality of cooling channels.

6. The gas turbine disk according to any one of the preceding claims, wherein at least one of the reinforcement parts continuously encompasses the exit of the corresponding cooling channel along a circumferential surface of the exit of said cooling channel.

7. The gas turbine disk according to any one of the preceding claims, wherein the reinforcement parts are continuously formed along a circumference formed by the exits of the plurality of cooling channels.

8. A gas turbine, comprising:

a plurality of disks according to any one of the preceding claims; and
a plurality of blades arranged on outer circumferential surfaces of the disks.

Fig.1

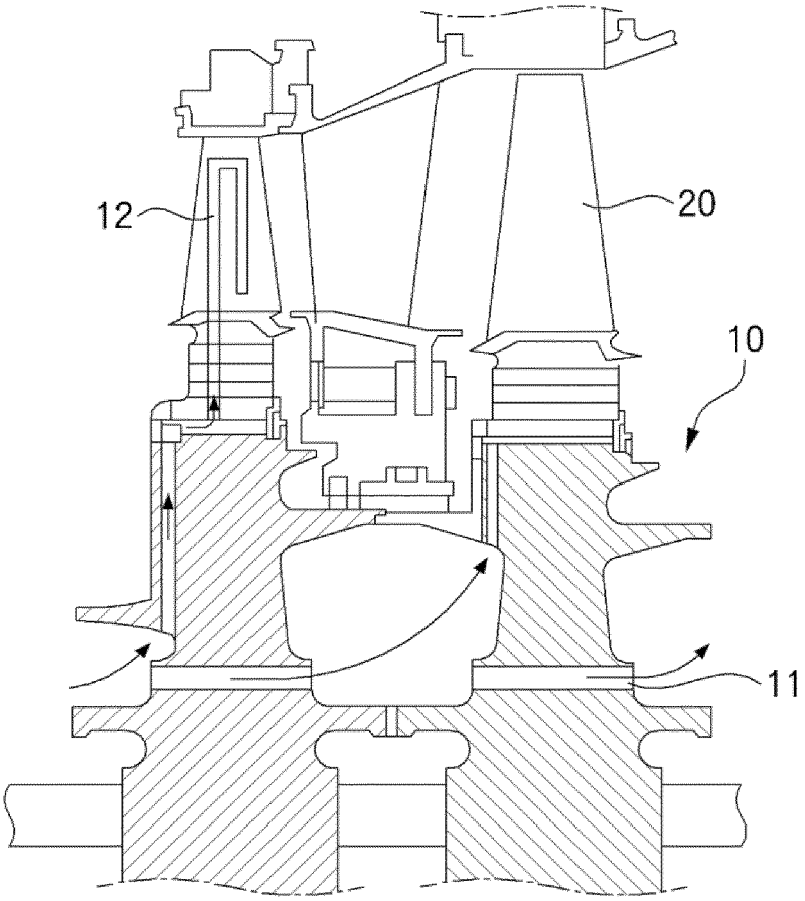


Fig.2A

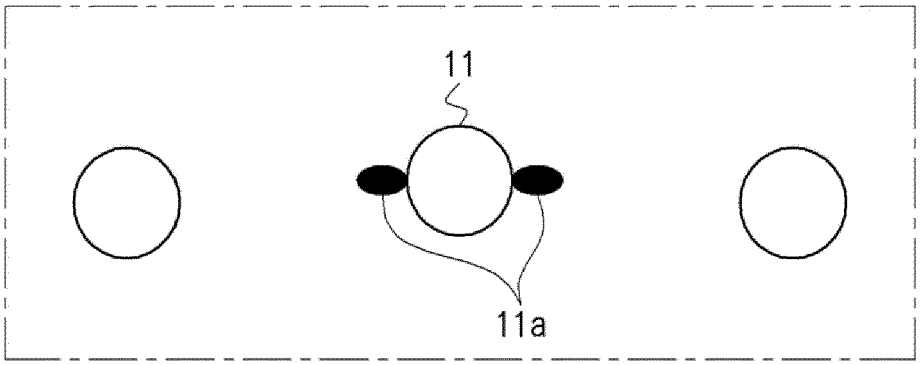


Fig.2B

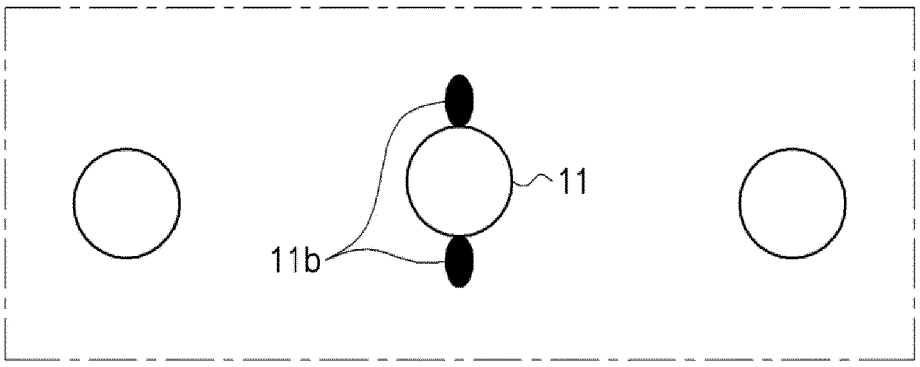


Fig.3

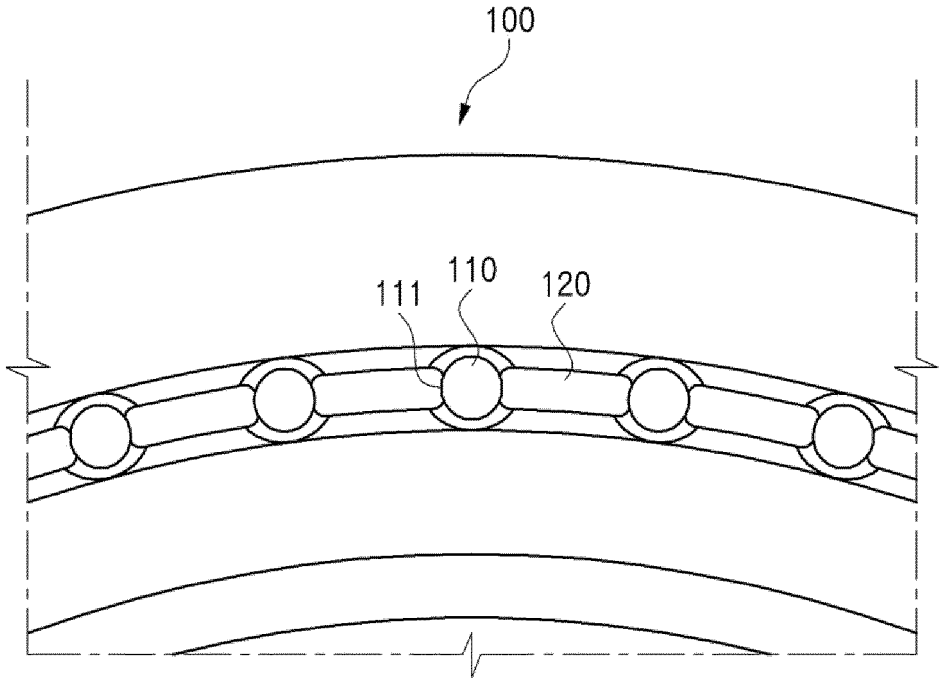


Fig.4

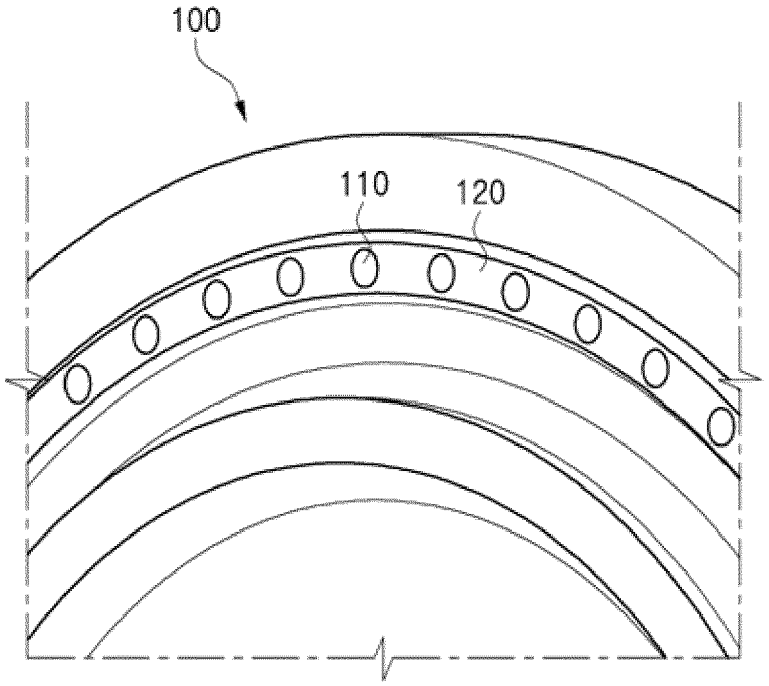
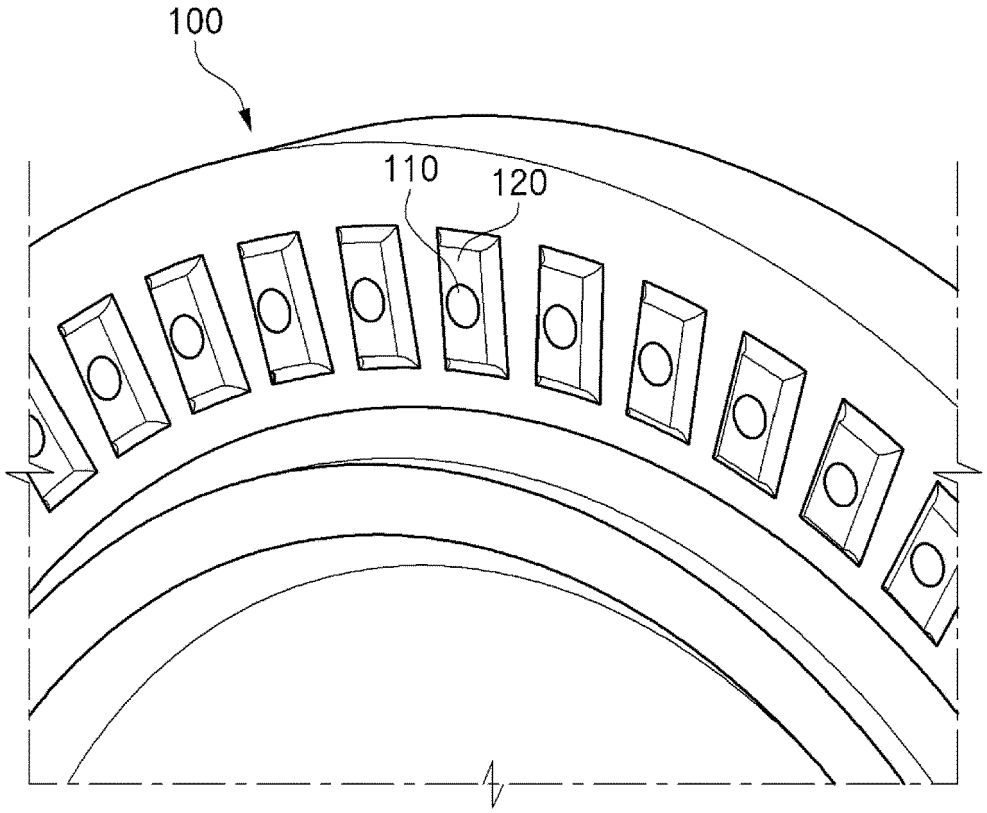


Fig.5



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EUROPEAN SEARCH REPORT

Application Number
EP 16 18 0337

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 January 2017	Teissier, Damien

CATEGORY OF CITED DOCUMENTS

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